

## NOTEWORTHY COLLECTION

## CALIFORNIA

*SPHAEROPTERIS COOPERI* (Hook. ex F. Muell.) R. M. Tryon (synonym *Cyathea cooperi* (Hook. ex F. Muell.) Domin (CYATHEACEAE) (Australian tree fern, Cooper's tree fern).—Los Angeles Co., Santa Catalina Island, Twin Rocks, channel-side coastal bluff, uncommon but widespread along open, rocky cliff faces, characterized by exposed, granitic and sedimentary sandstone soils, and very little annual rainfall, 33°24'50"N, 118°22'26"W, elev. 218 m (715 ft), 23 June 2011, J. R. Clark 1020 with T. Dvorak, C. de la Rosa, S. Ratay, and T. M. Summers (CATA, RSA, SBBG, UC).

*Collection notes.* Associated species include *Dudleya virens* (Rose) Moran subsp. *hassei* (Rose) Moran, *Mimulus aurantiacus* Curtis var. *parviflorus* (Greene) D. M. Thoms., *Opuntia littoralis* (Engelm.) Cockerell, and *Rhus integrifolia* (Nutt.) Benth. & Hook. f. ex Rothr. A stand of *Lyonothamnus floribundus* A. Gray subsp. *floribundus* (the endemic Catalina ironwood) is also present near the site, although no *S. cooperi* are immediately adjacent to this stand. Only two other fern species were documented in the vicinity, a single individual of *Woodwardia fimbriata* Sm. growing in a damp seep along the south side of the bluff and scattered individuals of *Polypodium californicum* Kaulf. growing mostly in shaded areas.

A general survey of the locality was undertaken and at least 20 individuals of *S. cooperi* were observed growing in and among the cracks and hangs of the bluffs. Some of these individuals were growing in areas that were accumulating and storing water while others appeared to be growing directly from the dry, barren rock faces. Aspect did not appear to have bearing on plant establishment; all slopes of the formation had *S. cooperi* individuals growing on them. Species directly associated with individual *S. cooperi* plants were few, and of these *Mimulus aurantiacus* was most commonly seen in physical proximity to the ferns.

Individual plants of *S. cooperi* ranged in size from less than one meter in height, including fronds, to approximately 1.5 meters total height. The largest trunk observed measured approximately one meter tall with a diameter of approximately 10–15 cm. Fronds were on average one meter in length, although smaller on some individuals growing in particularly exposed areas. All plants that were physically accessible were observed to have fertile fronds and were actively releasing spores via sori near the distal ends of the fronds. Older, dead fronds did not appear to be dehiscing from the trunk as is thought common for the species (Medeiros et al. 1992); instead, on all observed specimens, trunks were routinely covered in dead fronds. Age could not be assessed, but previously unidentified photographs of the naturalized tree ferns from 2007 were recently discovered and reviewed in preparation for this paper (Catalina Island Conservancy private photograph collection; images not shown). Based on this finding, the population is at least 6 years old and most likely older, considering the size of specimens in the photographs.

*Previous knowledge.* *Sphaeropteris cooperi* is a commonly planted ornamental tree fern species native to the subtropical rainforest of eastern Queensland and

eastern New South Wales, Australia. Cultivated widely in much of the temperate, subtropical, and tropical world, the species exhibits considerable ecological tolerance, being capable of survival in a variety of conditions from periodic cold and freezing to extreme heat – so long as ample water is available. The species has long been used ornamentally, particularly in Hawaii and other tropical Pacific islands (Medeiros et al. 1992; Wagner 1995). In North America, *S. cooperi* has been widely cultivated and is commonly seen in managed landscapes throughout California and as far north as British Columbia, as well as in the American Southwest where irrigation is regular, and into the Southeast as far South as Florida and the Caribbean (Wood 2008).

*Significance.* First report of the species being naturalized in California. The potential for invasiveness by *S. cooperi* is thought to be high in the wet tropics and the species is considered a noxious weed in all of Hawaii (Medeiros et al. 1992) as well as other tropical regions including Mauritius and Madagascar. Moist subtropical and even temperate areas have also been invaded by *S. cooperi* including southern regions of Eastern and Western Australia and, most recently documented, a restricted coastal region of the temperate rainforests of Oregon, USA (Wood 2008). The discovery of a naturalized population in southern California represents the first-ever report of the species being naturalized in a markedly dry, Mediterranean-type climate.

Recent research in modeling natural and escaped ranges for potentially invasive species suggests that native ranges and ecologies might under-predict the diversity of habitats available to a particular species for invasion (Fitzpatrick et al. 2007; Pearman et al. 2007; Rödder and Lödders 2009; Mandle et al. 2010). The discovery of a naturalized population of *S. cooperi* on Catalina Island in an area of relatively high exposure and very little apparent moisture supports this prevailing notion. However, habitats such as the California Channel Islands that at first appear unsuitable for wet-loving species such as *S. cooperi* should be reconsidered in light of phenomena such as a persistent marine layer and fog drip that can dramatically increase available moisture (Fischer et al. 2009). These and other environmental variables, if modeled, might accurately reflect true invisable ranges for the species (Peterson and Nakazawa 2008; Mandle et al. 2010).

Within species variation and local adaptation must also be considered in explaining the apparent range expansion for *S. cooperi* (Broennimann et al. 2007; Mandle et al. 2010; Wang and Guan 2011). Ferns in general are ecologically plastic and both the gametophytic and sporophytic generations exhibit the propensity to tolerate and adapt to harsh environments (Watkins et al. 2007), including those created following disturbance and/or dispersal to new and different environments (Page 2002; Saldaña et al. 2007). Many ferns including *S. cooperi* exhibit high reproductive output via spores that are highly dispersible, factors that might be contributing to dispersal to, and increased odds for, establishment in drier and presumably less-typical environments for the species (Durand and Goldstein 2001; Page 2002; see also Lavergne and Molofsky 2007).

Regardless of cause, the potential for additional naturalized populations of *S. cooperi* along the California coast and other coastal Mediterranean environments worldwide is expected. Research into modeling and identifying these expected ranges and localities is therefore justified. On-the-ground surveys are also needed to locate and manage naturalized populations, if and where they exist. The novelty of this recent discovery of naturalization and potential ecological range expansion warrants additional field observation and study as well as population genetics research. As of this publication, the Catalina Island population of *S. cooperi* is being closely monitored but not eradicated to facilitate current and future study.

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